COMPARISON OF OPEN DISCECTOMY WITH MICROENDOSCOPIC DISCECTOMY IN LUMBAR DISC HERNIATIONS: RESULTS OF A RANDOMIZED CONTROLLED TRIAL

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Received, December 8, 2006.
Accepted, April 4, 2007.

OBJECTIVE: We compared the intra- and postoperative differences, as well as the final outcome of patients with herniated lumbar discs who underwent either open discectomy (OD) or microendoscopic discectomy (MED).

METHODS: We performed a prospective controlled randomized study of 40 patients with sciatica caused by lumbar disc herniations nonresponsive to conservative treatment who underwent OD or MED with a 24-month follow-up period. Pre- and postoperative neurological status, pain, and functional outcome were evaluated. Other studied variables were the duration of the procedure, blood loss, time of hospital stay, and time to return to work. Statistical analysis with a P value less than 0.005 was carried out.

RESULTS: The only statistically significant differences found were for size of the incision, length of hospital stay, and operative time. The former two were greater in the OD group ($P < 0.01$ and $P = 0.05$, respectively), and the latter was greater in the MED group ($P < 0.01$).

CONCLUSION: The few parameters that were found to be statistically significant between the groups did not affect the overall outcome. In the current series, the final clinical and neurological results were similarly satisfactory in both the OD and the MED groups.

KEY WORDS: Comparative study, Lumbar disc herniation, Microendoscopic discectomy, Open discectomy, Surgery

Neurosurgery 61:545–549, 2007 DOI: 10.1227/01.NEU.0000280008.72190.15 www.neurosurgery-online.com

Lumbar disc herniations are a common cause of sciatica (16). More than half of the affected patients respond to conservative treatment (10, 13). Surgical discectomies, either through an open approach or using the more modern microscopic or endoscopic approaches, are indicated for those patients with persistent incapacitating low back pain and sciatica after at least 6 weeks of treatment or in those with early or progressive neurological impairment (8, 10).

In 1934, Mixter and Barr (9) first described laminectomy and discectomy to treat herniated lumbar discs. Surgical results using these techniques were often poor, especially regarding pain, mostly because of the extensive muscular dissection required for the open approach (3, 20). To address these issues, Caspar (2), Yaşargil (20), and Williams (19) described the microsurgical discectomy technique that involved a monosegmentar, minimally invasive approach using specially designed instrumentation and a surgical microscope. In 1971, Simeone (15) described the use of a surgical telescope (loupe) to substitute the microscope, acquiring similar results.

Thus, "microsurgical discectomy" is a term currently used to describe a surgical technique involving a small incision with minimal paravertebral muscle dissection using magnification, which may be either microscopic (19) or using a loupe (16). This is considered the "gold standard" for the treatment of disc herniations.

In 1997, Foley and Smith (7) developed an endoscopic approach as a minimally invasive surgical alternative for the treatment of lumbar disc herniations. The herniated tissue is resected endoscopically through a posterior

approach using a small incision and a tubular retractor (16 or 18 mm in diameter). This microendoscopic discectomy (MED) is thought to cause less tissue damage than standard open microdiscectomy with a marked reduction in postoperative pain and muscle spasm, allowing the procedure to be performed in an outpatient setting and enabling patients to return to their activities sooner (7, 8, 11). It also allows direct vision of the nerve root and bone decompression (12).

Despite all of the technical refinements, surgical treatment of herniated discs still remains controversial (18). Although excellent results have been reported after discectomy, relief of low-back pain has been less predictable (1, 4, 16, 18). Only a small number of studies have compared the outcome of patients using the open discectomy (OD) and MED techniques (14, 16). The objective of the current prospective randomized study was to compare the outcome of patients with persistent sciatica secondary to lumbar disc herniation treated with either OD or MED technique.

MATERIALS AND METHODS

After institutional review board approval, patients with sciatica caused by herniated lumbar discs who did not respond to conservative treatment were randomly enrolled in the treatment protocol to undergo either OD or MED between June 2001 and September 2004. The inclusion criteria were the presence of a posterolateral herniated lumbar disc observed on magnetic resonance imaging scans and the persistence of sciatica after 4 to 8 weeks of conservative treatment with rest, analgesia, nonsteroidal anti-inflammatory drugs, and physical therapy. The exclusion criteria were as follows: age older than 60 years, previous surgery, associated lumbar spine stenosis, foraminal or extraforaminal disc herniations, spondylolisthesis, and workers' compensation payments. Only those patients with a final postoperative follow-up period of at least 2 years were included in this study.

After the inclusion criteria were met and informed consent was obtained, patients were allocated randomly into one of two groups: Group 1 underwent OD; and Group 2 underwent MED. The surgical procedures were performed under general anesthesia with the patient in the prone position. Prophylaxis with a first-generation cephalosporin was introduced 1 hour before anesthesia and kept for 8 hours after the procedure.

Patients in Group 1 underwent OD following Caspar's technique modified only by the use of a surgical magnifying loupe of $\times 2.5$ (Designs for Vision, Inc., Ronkonkoma, NY) and a halogen headlight (Designs for Vision, Inc.), instead of the surgical microscope (3). In this technique the paravertebral muscles are swept laterally from the lamina in a subperiosteal plane, using the lamina as a landmark. A self-retaining retractor is placed, and the discectomy is performed using a magnifying surgical loupe. Patients in Group 2 underwent MED following the technique described by Foley and Smith (7).

The surgical variables analyzed were the level and side of the herniated disc, side of root compression, duration of the procedure, blood loss, presence of complications, duration of hospital stay, opioid administration, and incision size. Postoperative braces were not used, and the patients were kept in the hospital until adequate pain control was achieved.

Pre- and postoperative evaluation consisted of a neurological examination, the Visual Analogue Scale (VAS), and the Oswestry Disability Index (5, 6, 17). The surgical wound pain was assessed 12 hours after surgery by using the VAS. The VAS scores the intensity of pain from 0 (absence of pain) to 10 (worst pain ever experienced) (17). Clinical neurological status was evaluated using the Lasegue test, motor assessment by muscle strength, and testing of the reflexes and sensibility. Functional outcome was evaluated using the Oswestry Disability Index (6). The patients were reevaluated 1, 3, 6, 12, and 24 months after surgery. The time required for patients to return to work was also registered.

Data were analyzed using the χ^2 and Fisher exact tests, as well as Student's t and Mann-Whitney tests when applicable, with a significance level established at 95% ($P < 0.05$) and statistical power established at 90% ($\beta = 0.10$).

RESULTS

A total of 40 patients were enrolled, 19 in Group 1 and 21 in Group 2 (*Table 1*). The mean postoperative follow-up period was 36 months in Group 1 (range, 24–46 mo) and 36.2 months in Group 2 (range, 25–56 mo).

In Group 1 (OD), there were 13 men and 6 women, with a mean age of 46 $\pm$ 12.4 years. The vertebral level affected was L4–L5 in 11 patients (57.9%) and L5–S1 in eight patients (42.1%); the left side was most commonly affected (12 patients [63%]). All patients in Group 1 presented with preoperative neurological impairment; 100% had a positive Lasegue sign (19 out of 19), 100% had motor deficits (19 out of 19), 74% had sensory deficits (14 out of 19), and 63% had impaired or absent reflexes (12 out of 19). After 6 months of follow-up, 37% had motor deficit, 42% had sensory deficit, and 63% had altered reflexes. After 12 months, these percentages changed to 26, 42 and 63%, respectively, and after 24 months, they changed to 26, 37, and 58%, respectively. One patient presented recurrence of the herniation 24 months after surgery and underwent another operation.

Group 2 (MED) was composed of 10 men and 11 women with a mean age of 42.0 $\pm$ 10.7 years. The vertebral level affected was L2–L3 in one patient (4.8%), L3–L4 in one patient (4.8%), L4–L5 in 11 patients (52.4%), and L5–S1 in eight patients (38.1%). The left side was most commonly affected (13 patients, 61.9%). All patients in this group presented with preoperative neurological impairment; 90% with a positive Lasegue sign (19 out of 21), 100% with motor deficits (21 out of 21), 91% with sensory deficits (20 out of 21), and 86% with impaired or absent reflexes (18 out of 21). After 6 months of follow-up, 67% had motor deficit, 67% had sensory deficit, and 62% had altered reflexes. After 12 months, these percentages changed to 38, 48, and 57%, respectively, and after 24 months, they changed to 33, 38, and 48%, respectively (*Table 2*). Opioid therapy was used in three patients (14%). The complications observed in this group were a recurrence of the disc herniation after 18 months requiring surgical treatment in one patient, a seroma that resolved spontaneously with complete recovery in one patient, and a dural tear that resolved with conservative treatment prolonging hospital stay to 48 hours in one patient.

When comparing Group 1 (OD) with Group 2 (MED), the only statistically significant differences found were for the following variables: the size of the incision, length of hospi-

TABLE 1. Comparison between Groups 1 (open discectomy) and 2 (microendoscopic discectomy)[a]

Variable	OD n = 19	MED n = 21	*P* value
Age (yr)	46.0 ± 12.4	42.0 ± 10.7	0.28
Sex, no. (%)			0.31
Male	13 (68.4)	10 (47.6)	
Female	6 (31.6)	11 (52.4)	
Duration of symptoms (d)	60 (30–210)	60 (30–180)	0.71
Length of hospital stay (h)	26 (16–72)	24 (11–72)	0.05[b]
Surgical time (min)	63.7 ± 15.5	82.6 ± 21.9	<0.01[b]
Blood loss (mL)	40 (11–450)	50 (10–700)	0.98
Size of incision (cm)	2.6 ± 0.4	2.1 ± 0.2	<0.01[b]

[a] OD, open discectomy; MED, microendoscopic discectomy. Data are represented as mean ± standard deviation, median (minimum and maximum), or percentage.
[b] Statistically significant difference.

TABLE 2. Neurological status of Groups 1 (open discectomy) and 2 (microendoscopic discectomy) before and after surgery[a]

Variable	OD n = 19	MED n = 21	*P* value
Motor deficit			
Preoperative	19 (100)	21 (100)	NA
1 mo postoperative	16 (84)	17 (81)	0.99
3 mo postoperative	15 (79)	17 (81)	0.99
6 mo postoperative	7 (37)	14 (67)	0.11
12 mo postoperative	5 (26)	8 (38)	0.51
24 mo postoperative	5 (26)	7 (33)	0.74
Sensory deficit			
Preoperative	14 (74)	19 (91)	0.23
1 mo postoperative	12 (63)	17 (81)	0.29
3 mo postoperative	12 (63)	16 (76)	0.49
6 mo postoperative	8 (42)	14 (67)	0.20
12 mo postoperative	8 (42)	10 (48)	0.76
24 mo postoperative	7 (37)	8 (38)	0.99
Altered reflexes			
Preoperative	12 (63)	18 (86)	0.15
1 mo postoperative	12 (63)	14 (67)	0.99
3 mo postoperative	12 (63)	13 (62)	0.99
6 mo postoperative	12 (63)	13 (62)	0.99
12 mo postoperative	12 (63)	12 (57)	0.76
24 mo postoperative	11 (58)	10 (48)	0.55

[a] OD, open discectomy; MED, microendoscopic discectomy; NA, not available. Data are presented as percentages.

tal stay, operative time, and immediate postoperative pain at the incision. The two former variables were greater in the OD group ($P < 0.01$ and $P = 0.05$, respectively), and the latter two were greater in the MED group ($P < 0.01$ in both) (*Tables 1* and *3*).

The VAS score (*Fig. 1*) and Oswestry Disability Index (*Fig. 2*) improved significantly in Groups 1 and 2 postoperatively, and there was only one statistically significant difference in VAS after 12 hours of surgery (*Table 3*). The mean time to return to work and normal activities was 21 days in both groups, ranging from 7 to 60 days in Group 1 and from 4 to 45 days in Group 2. The difference between the groups was not found to be statistically significant ($P = 0.79$).

DISCUSSION

The demands of modern society create the need for faster recoveries, allowing patients to resume their normal activities sooner. Technical developments in the past decades have made the treatment of herniated discs safer and less invasive. By using microsurgical or microendoscopic approaches through small incisions, nerve root decompression is achieved with minimal risk of complication and preserving normal anatomy (19). Foley and Smith (7) believe that MED is superior to other percutaneous techniques for combining the standard lumbar microsurgical technique with endoscopy, allowing the surgeon

TABLE 3. Comparison between surgical Groups 1 (open discectomy) and 2 (microendoscopic discectomy)[a]

Variable	OD n = 19	MED n = 21	*P* value
VAS for pain			
Preoperative	9 (7–10)	7.9 (6–10)	0.03
12 h postoperative	1.2 (0–5)	2 (1–4)	<0.01[b]
1 mo postoperative	1.2 (0–3)	1.5 (0–6)	0.33
3 mo postoperative	1 (0–2)	0.8 (0–6)	0.50
6 mo postoperative	1 (0–3)	1 (0–6)	0.27
12 mo postoperative	0 (0–3)	0 (0–3)	0.67
24 mo postoperative	0 (0–6)	1 (0–3)	0.15
Oswestry Disability Index			
Preoperative	50 (22–96)	54 (28–100)	0.65
1 mo postoperative	10 (0–48)	12 (2–44)	0.39
3 mo postoperative	11 (0–36)	8 (0–42)	0.49
6 mo postoperative	10 (0–24)	10 (0–40)	0.89
12 mo postoperative	8 (0–20)	10 (2–34)	0.23
24 mo postoperative	10 (0–30)	10 (0–22)	0.87

[a] OD, open discectomy; MED, microendoscopic discectomy; VAS, Visual Analogue Scale. Data are represented as mean ± standard deviation, median (minimum and maximum), or percentage.
[b] Statistically significant difference.

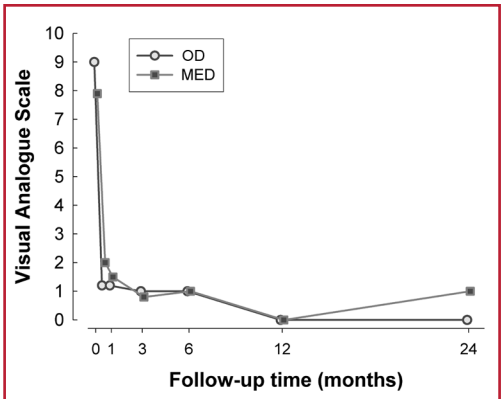

FIGURE 1. *Line graph demonstrating the comparative results of the postoperative pain between Groups 1 (OD) and 2 (MED) using the VAS.*

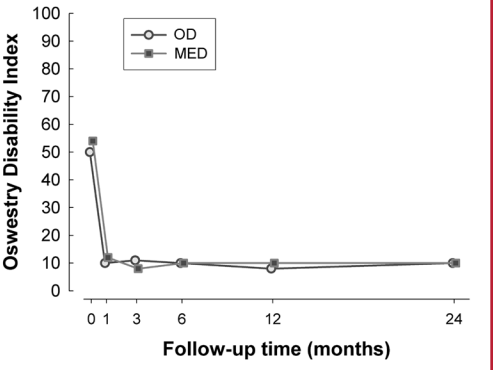

FIGURE 2. *Line graph demonstrating the results of the Owestry Disability Index for evaluation of functional outcome after surgical repair of lumbar herniated disc comparing Groups 1 (OD) and 2 (MED).*

to address free-fragment disc pathology and lateral recess stenosis through an even smaller incision than OD and with less trauma. The improved optical conditions allow better differentiation of the anatomic structures with gentler manipulation of the nerve root and dural sac (2, 3).

The high rate of early neurological deficits reported in the current series may reflect the greater number of acute cases and the volume of the herniation. Although no statistically significant differences were found regarding neurological recovery between the groups, the OD group recovered both motor and sensory functions earlier than the MED group. However, after a 24-month follow-up period, both groups presented similar results.

The operative time was greater in the MED group, but within the average reported by surgeons experienced with the technique (2, 3, 11, 19). The hospital stay was longer in the OD group, but only by an average of 2 hours, which represents little significant clinical or economical difference. Clinical outcome was satisfactory and comparable in both groups.

The superiority of microdiscectomy over traditional discectomy has been widely proven (7, 10, 11, 20). However, there is no randomized clinical study comparing the OD and MED techniques. To our knowledge, this is the first prospective randomized clinical study to compare the clinical outcome and technical aspects of both techniques.

CONCLUSION

The few parameters that were found to be statistically different between the groups (incision size, length of hospitalization, operative time, and VAS at 12 hours) did not affect the overall outcome. Up to the present, the current study included, the technical superiority of the videoendoscopic technique has not been proven, but it may become an interesting alternative for those patients who require faster recoveries.

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COMMENTS

Righesso et al. performed a prospective randomized study of 40 patients with sciatica due to lumbar disc herniations. Patients were treated with either an open microsurgical discectomy or a microendoscopic discectomy (MED). The follow-up period was just over 3 years. Essentially, there was no significant difference between the clinical outcomes of the two groups. Those having an open procedure had a larger incision and a hospital stay lasting 2 hours longer, both of which were significantly different compared with these parameters for the MED group. The MED procedure required approximately 20 minutes longer than the open procedure, which was also statistically significant.

This study highlights the similarities in terms of outcome between these two procedures. It should be noted that the authors used a muscle-splitting approach in their open procedure very similar to that used for MED. This is probably a key factor in minimizing postoperative morbidity and earlier return to function. Once the exposure is achieved, whether the surgeon chooses to use a microscope or endoscope does not seem to make much difference.

Vincent C. Traynelis
Iowa City, Iowa

The authors performed a randomized controlled study comparing MED and microsurgical discectomy. They found that the results of both procedures were generally excellent and that there were no important differences between the groups. The "significant" differences noted in incision length and length of stay were clinically meaningless (5 mm and 2 hours, respectively). The MED procedures required approximately 20 minutes longer and used more expensive equipment. The results of this study indicate that modern microsurgical procedures provide excellent results in correctly selected patients. Surgeons should select the procedure they are most comfortable with and become familiar with the tools necessary for the facile performance of such procedures. More expensive and trendy procedures should not be adopted over well proven alternatives unless there is a benefit in patient outcome.

Daniel K. Resnick
Madison, Wisconsin

In the present study, Righesso et al. describe the results of a randomized study of open discectomy versus MED in a select group of 40 patients. All harbored posterolateral disc herniations and experienced symptoms unresponsive to nonoperative treatment. Patients in both groups recovered to a similar degree. The size of incision and length of hospital stay were significantly longer in the open discectomy group, whereas operative time was significantly longer in the MED group. The authors conclude that the procedures yield similarly satisfactory results.

Overall, this is an interesting study within its limitations, the primary one being sample size. Although many would argue that the use of loupes and a headlight is not equivalent to the use of an operating microscope, it is instructive to note that there were still no significant outcome differences. These data highlight the difficulty of improving on the "gold standard."

Christopher E. Wolfla
Milwaukee, Wisconsin

Righesso et al. are to be congratulated for putting together a prospective randomized trial comparing open discectomy to MED in the treatment of lumbar herniated discs. I am mystified by the fact that we derive our knowledge of a procedure performed hundreds of thousands of times each year from 40 patients. Be that as it may, the authors state that the statistical power of this study is 90%.

The authors' conclusion is that it is hard to improve on the standard procedure for herniated lumbar disc. The most important endpoint, time to return to work, is not affected by the procedure performed. The three statistically significant differences are operator-dependent. The authors performed open surgery using loupe magnification. The operating microscope affords the surgeon three-dimensional vision through a smaller opening. Thus, a 5 mm difference in the length of the incision could be reduced by the use of the operating microscope. It is not clear how it was decided when to discharge the patients after surgery. Thus, it is hard to know that the 2 hour difference in duration of hospitalization was a result of the surgical procedure. Although I imagine that the MED operation takes longer to perform, the exact operating time will depend on the skill and experience of the surgeon. It is hoped that others with a focused interest in spine surgery will repeat this study.

Allan H. Friedman
Durham, North Carolina

This is a well-organized, simple study comparing standard microdiscectomy techniques with microendoscopic techniques. Importantly, it is a rare prospective, randomized study comparing the two techniques. The authors' results show equivalence in outcomes for the two techniques. Despite the vigorous industry promotion of new instruments for microendoscopic techniques and the popularity of this topic at professional meetings, the superiority of these "minimally invasive" techniques has not yet been established.

After many years of experience with rod-lens scopes and tubular retractors at our institution, we have adopted a combination of these two techniques. We have returned to using the operating microscope with tubular retractors and the muscle-dilating approach described by Foley and Smith (1). The enhanced ability to focus the beam of light and improved microscope optics in general have rendered the rod-lens scope obsolete in microdiscectomy procedures in our institution.

Lastly, it should be noted that one significant advantage of the sequential muscle-dilating and tubular retractor placement is in obese patients. Any open technique that involves subperiosteal stripping of the paraspinal muscles and placement of blade retractors in obese patients usually requires a much larger incision, whereas tubular retractors are now available in a variety of extended lengths. The diameter of the tube and length of skin incision can be quite small and reproducible, yet presumably less painful and cosmetically more satisfactory.

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